



OCT 18 1917

## GLACIERS

1. A View of Roosevelt Glacier from Heliotrope Camp  
(Roosevelt Glacier is on Mt. Baker, a Peak of the  
Cascade Range, 10,500 Feet High, Located in  
Whatcom County, Washington.)
2. Mt. Shuksan. East of Mt. Baker.
3. Leaving for the Glaciers of Mt. Rainier.
4. Sliding on Mt. Rainier.
5. Glacier Crevasses on Mt. Rainier.
6. Snoqualmie Falls, King's County, Washington, 270  
Feet in Height.  
(Snoqualmie River, 70 Miles Long Rises in Cascade  
Range. It is Fed by Melting Glaciers.)
7. Childs Glacier, Alaska.  
(The Ice Wall of the Glacier as it Reaches the Sea  
is 300 Feet High.)
8. Steamship in the Ice Floes in Early Summer, 50  
Miles from Nome, Alaska.
9. Shore-Ice at Cape Prince of Wales, Alaska, the Most  
Westerly Point in North America.
10. Eskimo Hunters Returning over Fields of Moving  
Ice in Behring Straits.
11. At Cape Prince of Wales.  
(Eskimos on Shore-Ice Two Miles from Land.  
Eskimos Removing Snow Shoes.)

## GLACIERS

OVER most of the continents the climate is such that rivers, fed by rain and melted snow, extend their courses to the sea. The flowing rivers, aided by the weathering and washing of soil, carve valleys in the land surface; hence, valleys are marked characteristics of the lands, in contrast to the sea floors, which are smoothed by layers of sediment.

But some parts of the continents receive so little rainfall that most of their streams are of intermittent flow and their rivers do not reach the sea. These arid regions or deserts have well-carved valleys in their higher parts; but their barren lower parts are usually covered with the land waste from the highlands, and valleys are absent. Here the wind may be an important factor in sweeping about the detritus and changing the form of the surface. On still other parts of the continents, especially on lofty mountains and in the polar regions, where rain is largely replaced by snow and where the snowfall of the colder season is not all melted in the following warmer season, snow accumulates to great thickness and is gradually compacted to granular ice. In Greenland and on the Antarctic continent, the ice covers the land far and wide in a heavy sheet, hundreds of feet in thickness; it becomes so thick in the higher central area that it slowly creeps to the lower coasts. Such ice sheets are called continental glaciers.

The Greenland glaciers reach oceans or its bays before melting and there huge masses of ice break from the front of the glacier and float away. Such masses are known as icebergs. About  $\frac{6}{7}$  of an iceberg is submerged. There-

fore when explorers tell us that the visible parts of many icebergs rise 100 to 250 feet above the sea surface we vaguely realize the immensity of these icebergs and the dangers they present to navigation. The icebergs formed from the Antarctic glaciers are tabular in form and may measure half a mile or a mile in length.

On lofty mountains the snow accumulates to great thickness in the hollows between the peaks and ridges and is there transformed into granular ice, which slowly creeps down the valleys, melting as it descends. At last, the whole of its heavy and sluggish mass is converted into a slender and nimble stream of ice water. These creeping ice streams are called mountain glaciers. The larger a glacier and the steeper its slope, the faster it moves and the farther it descends before it is all melted.

At present mountain glaciers are found in the valleys of lofty mountains such as the Alps, Pyrenees, Caucasus, Himalayas and those on the western coast of both North and South America. Moist winds blowing toward the mountains deposit some of their moisture on the piedmont lowlands, mostly in the form of rain; but on rising to cross over the mountains the winds are cooled by expansion, and deposit moisture there chiefly in the form of snow.

Continental glaciers pluck and scour the rocks beneath them, and drag the detritus along beneath them, packing it into "hardpan"; the detritus that accumulates at the margin is called a terminal moraine. Mountain glaciers similarly pluck and scour the rocks of their bed, but they also receive detritus from the enclosing mountain sides, and carry it on their borders as "lateral moraines." Where two branches unite to form a trunk glacier, the adjoining lateral moraines unite and form a single "medial moraine" which may be traced as a dark ridge far down the trunk glacier. The side moraines unite at the end of the glacier, forming a "terminal moraine," where all the

material that is not carried farther down the valley by the ice water torrent, accumulates. The detritus that is dragged along beneath the ice as well as the bed rock on which it is dragged are scoured and scratched. The detritus that is carried on the surface retains an angular form.

Rivers have a swifter current in midstream; so mountain glaciers or mighty ice rivers have a swifter motion along their middle. As a result of the faster motion along the middle than at the sides, cracks are formed in the ice mass. The cracks are called crevasses; they may be from 5 to 50 feet wide and from 50 to 300 feet deep. Exploring in the upper region of a glacier is very perilous, for the crevasses there become covered with snow and an explorer, unless roped to his companions, may fall into one and be lost.

Crevasses aid in the drainage of a glacier. Through the crevasses in the ice mass many tiny surface streams find their way downward to the base of the glacier, where they unite and flow beneath the ice to its end; for this reason rushing streams usually issue from the end of glaciers. When a glacier is not much crevassed, the water may flow upon the surface in rivulets which unite into streams, sometimes several feet in width; but the streams usually fall into a crevasse before reaching the glacier end.

Glaciers are usually either gaining or losing volume: when gaining, they creep down a little faster, and their end advances; when losing volume, they creep slower, and their end melts back; they are then said to retreat. Climatic changes covering many years cause glaciers to vary in volume and hence in length. During many successive years the climate of a glacial region may become a little milder and drier. This change results in the glacier becoming thinner and moving slower, so that the ice at its end melts faster than it is replaced and the glacier therefore loses ground—it retreats. The converse is

also true. A cold, wet period will cause a glacier to thicken and advance more rapidly, but so slow is the motion of a glacier that several years may elapse before a gain or loss of volume in the snow reservoirs at its head will cause an advance or a retreat of its lower end.

Many of the glaciers of North America and most of those in other sections of the world have for several years been steadily retreating

Doubtless the Alps, with their nestling villages and clinging chalets, present a more picturesque spectacle to the mountain climber than do the mountains of North America, but all that the traveler can desire of grandeur and thrilling exploration is to be found in the great mountain ranges of the North American continent. The wonderful glaciers and glacier systems found upon these mountains are now visited yearly by great numbers of tourists and scientific investigators.

Mt. Rainier in the Cascade mountains rising nearly three miles above sea level (14,408 feet) has the largest and most wonderful glacier system in the United States (not including Alaska). Rainier is a dormant and dissected volcano. The snows of many seasons have settled into its mile-wide crater and radial valleys and by their enormous weight have been propelled down the mountain sides. Rainier has been aptly called the "Frozen Octopus" for through its rock-walled valleys flow slowly twenty-eight ice rivers stretching out like tentacles of this huge monster.

The glacier which is most frequently visited by the tourist is the Nisqually Glacier, one of the Rainier glacial system. It is five miles long and one-half mile wide and it is estimated that the ice is 1000 feet thick in some places. In the summer this glacier is said to move at midstream about 16 inches a day, or from 300 to 400 feet a year. Alpine glaciers move at similar small velocity.

The retreat of the Nisqually Glacier has been accurately observed during the last 25 years and it has been found to have retreated 1,000 feet during that time. A road used by tourists is now built on territory over which, in earlier years, the glacier extended.

We might think that no animal or plant life can exist in a glacial region, but such is not the case. At the present time there are known to be sixty species and varieties of snow and ice worms. About twenty-three of these species and varieties are found in North America. In the lower parts of the Rainier glaciers myriads of small dark brown worms exist, which get their food from the dust blown upon the glacier; they burrow into the ice several inches when the sun's rays are too warm. Numerous species of insects also exist in the glaciers and snow fields. Snow fleas or springtails sometimes occurring in numbers so great as to give a grayish color to the snow are found in the snow below the glaciers.

Explorers tell of the peculiar "red snow" found in glacial regions. The pink tint given to the snow is produced by millions of microscopic rose-colored plants living upon it. This "red snow" plant or alga is very hardy being able to grow and multiply even when covered with snow. "Brown snow," "yellow snow," and "green snow," each produced by different algae, are known to exist in various parts of the world.

Another interesting feature of glacial regions is the "flower zone." This is a zone of the mountain slope above the limit of timber growth, where snow does not remain through the summer, and where an abundant growth of flowering plants is found. Here beautiful wild flowers grow in abundance—daisies, anemones, columbines and larkspur making a charming and brilliant approach to the bleak, cold barrenness above, "as if nature," writes

John Muir, "glad to make an open space between woods so dense and ice so deep, were economizing the precious ground."

#### QUESTIONS, TOPICS, SUGGESTIONS

1. Describe a glacier. How are glaciers formed?
2. What causes them to move? How much do different glaciers move yearly?
3. What are crevasses? How caused?
4. What is a moraine? Name the three kinds of moraines and explain meaning of each term.
5. Name three large glaciers of North America.
6. What is a glacial stream? A glacial lake?
7. What is an iceberg? How formed? An ice floe?
8. Learn if any rocks in your vicinity show glacial action.
9. Mention briefly any disasters caused by icebergs or ice floes.
10. Reports on "Shackleton's Great Adventure in the Ice-locked South." cf.—Collier's, Jan. 20, 1917. Rev. of Rev., Feb., 1917.
11. Reports of Titanic Disaster. cf.—Current Literature. Vol. 52. May, 1912, pp. 487-8. Harper's Weekly. Vol. 56. Apr. 20, 1912.
12. The writings of Robert E. Peary will be of interest to the pupils.
  - cf. 1. Nearest the Pole.
  2. Snowland Folk.
  3. Journeys in Northern Greenland.
  4. Northward Over the Great Ice.

### QUESTIONS ON THE FILM

1. Describe what you saw in the foreground and background of the picture of the Roosevelt Glacier.
2. What did you learn from the picture of the Nisqually Glacier concerning the size and appearance of a glacier?
3. Where is this glacier?
4. How are the members of the tourist party ascending Mt. Rainier dressed and equipped? Why?
5. Describe the way in which the people were sliding on Mt. Rainier.
6. Into what is the tourist party looking? Describe it.
7. In the picture of the Snoqualmie Falls describe all you saw in the picture. What causes this fall?
8. Judging from the pictures, describe the difference between Childs Glacier and those in first scenes. (Nisqually for instance.)
9. Describe the difference in the floe ice seen in the two different scenes. When dangerous? When not?

### REFERENCES

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- COLEMAN, A. P. The Canadian Rockies. New and Old Trails. 1911.
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- ULKE, TITUS. Life on Glaciers and Snowfields. Scientific American Supplement. No. 2159.

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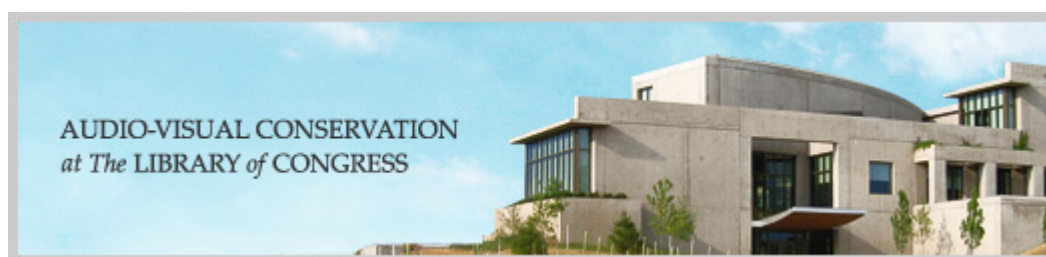
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